that it appears formerly to have been a spacious lagoon of the sea, of which these particular sand hills are the shore.

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## No. XLVII.

*Further Observations on the Eclipse of 16th June, 1806, being an Appendix to No. XLIII, page 264 of this Volume, by J. J. de Ferrer.*

Read April 17th, 1807.

SINCE the Memoir was printed I have received the following observations.

At the Hydrographic Repository at Madrid, Don Philip Bauza lieutenant in the Royal Navy, observed the beginning of the eclipse at $4^h$ 27′ 48″ 6, and the end at $6^h$ 09′ 07″ 2 apparent time. Latitude of the Repository 40° 25′ 08″. Longitude west of Paris 24′ 08″ in time. Magnifying power of the telescope 110.

At the Royal Observatory in the Island of Leon, Don J. M. de la Cuesta, lieutenant in the Royal Navy, observed the commencement $4^h$ 18′ 42″ 2 apparent time. The end was not observed on account of the clouds. Latitude of the observatory 36° 27′ 45″. Longitude west of Paris 34′ 08″.—Magnifying power of the telescope 53.

I have re-calculated all the observations of page 273, making use of the new solilunar tables, published in Paris, 1806, by the Commissioners of longitude. They are as follows, for $4^h$ 29′ 41″, mean time in Paris.

| | ° ′ ″ |
|---|---|
| Longitude of the ⊙'s apparent equinox. | 84 44 37 2 |
| Idem. ☽'s | 84 44 47 8 |
| North latitude of the ☽ | 00 19 19 3 |
| Horary relative motion in longitude. | 34 18 5 |
| Horary motion in latitude, south. | 3 23 6 |
| Horizontal equatorial parallax of the ☽. | 60 15 8 |
| Idem. ⊙. | 8 6 |
| Horizontal semidiameter of the ☽. | 16 26 85 |
| Horizontal semidiameter of the ⊙. | 15 46 04 |
| Horary increase of the ☽'s parallax. | 1 10 |
| Increase of the ☽'s horary movement. | 1 41 |

The other elements are the same as those in page 270.

Comparing the commencement at Madrid, with the commencement at the island of Leon, it appears that the observation at Madrid was delayed 7″.

Combining the beginning at the island of Leon with the end observed in Madrid, supposing the sum of the apparent semidiameters diminished 4″ 5 for the irradiation, we have the conjunction in Paris mean time 4ʰ 30′ 11″ 6. Correction of tables in latitude of the moon=+10″ 9.

In Boston, latitude 42° 21′ 13″, longitude west of Paris 4° 53′ 28″, it was observed by three persons with achromatic telescopes, which I shall distinguish by the numbers 1, 2, 3.

| | Beginning of the Eclipse. ʰ ′ ″ | Total obscurity. ʰ ′ ″ | End of obscurity. ʰ ′ ″ | End of the Eclipse. ° ′ ″ |
|---|---|---|---|---|
| No. 1. | 10 03 21 | 11 22 31 | 11 27 09 | 0 48 01 |
| 2. | 10 03 21 | 11 22 31 | 11 27 09 | 0 48 59 |
| 3. | 10 03 20 | 11 22 40 | 11 27 08 | 0 48 07 |

The state of the chronometer is not known, because no observations were made to ascertain the time, and the only use that can be made of these observations, is to determine the error of the tables in latitude, or, knowing this element, to determine the difference of the semidiameter of the sun and moon.

I have again examined the corresponding altitudes observed by M. de Witt at Albany, and have determined that

| | ʰ ′ ″ |
|---|---|
| The commencement of the total obscurity, mean time. | 11 08 14 6 |
| End. ditto. | 11 13 05 6 |
| Duration according to M. de Witt. | 4 51 |

Applying the calculation to the observations of Kinderhook, supposing the correction of the tables in latitude =+ 10″ 9 as it results from the observations of Madrid and the island of Leon.

| | |
|---|---|
| We have irradiation of the semidiameter of the ☽. | =—3″ 25 |
| Idem. ⊙. | —1 25 |

With these elements we have the conjunction

| At Kinderhook. | Mean time. h ′ ″ | |
|---|---|---|
| For the beginning of the eclipse. | 11 25 40 9 | |
| Total obscurity. | 11 25 40 7 | 11h 25′ 40″ 7 |
| End of total obscurity. | 11 25 40 7 | |
| End of the eclipse. | 11 25 40 5 | |
| In Albany with the same elements, conjunction in mean time. | | |
| For the beginning of total obscurity. | 11h 25′ 47″ 2 | |
| End. ditto. | 11 25 57 0 | |

Comparing the beginning of the total obscurity at Kinderhook with the beginning of the total obscurity at Albany, it results that Albany is east of Kinderhook. . . = 6″ 5

By the chronometer, page 269. . . . = 6 7

This determination appears to be correctly ascertained, and to prove indubitably, that there was an error of about 10″ in the end of total obscurity: it will not be improper to note that the interior contacts are instantaneous, and therefore the half second easily distinguishable.—Therefore the error should be attributed, to taking one decimal for another, the same remark should be made on the Boston observations.

Indeed, on applying the calculation, it results that the number 3, in place of taking 11h 22′ 30″, made a mistake and took 11h 22′ 40″, so that the duration of total obscurity No. 1, 2, appears to be the most likely to be correct.

Suppose the longitude of Boston 4h 53′ 28″, we have the chronometer slow to mean time 2′ 02″.

| | ′ ″ | |
|---|---|---|
| Duration of total obscurity by observations 1 and 2. . . | 4 38 | |
| In Albany. . . . . | 4 41 | |
| In Kinderhook. . . . . | 4 37 | |
| In Boston the shortest distance from the centres. . . . | 14 7 | N. |
| Albany. . . . . | 6 1 | S. |
| Kinderhook. . . . . | 9 7 | N. |

As the moon at Albany passed to the south of the centre of the sun, and in Kinderhook and Boston to the north of it, by combining the three observations, the result is as follows:

| | |
|---|---|
| Correction of the tables in latitude. . . . . | + 10″ 5 |
| Irradiation of the ☾'s semidiameter. . . | 3 15 |
| Irradiation of the ☉'s semidiameter. . . | 1 35 |

With the same elements we have the conjunction in Lancaster.

For the beginning 11h 15′ 25″ 3 mean time.
End. . 11 15 31 9 ditto.

It appears that the commencement has been anticipated 6″ or 7″ by some error, let us see whether this doubt can be cleared up.

The solar eclipse of the 26th of June 1805 was observed by Mr. Ellicott in Lancaster.

| | | | | |
|---|---|---|---|---|
| Beginning, apparent time. . 6h 43′ 26″ } Observed by myself in New-York. 6 50 10 } from whence diff. of mer. | | | = 9′ | 16″ |
| Kinderhook east of New-York page 269. . . . | | | 0 51 | 3 |
| Kinderhook east of Lancaster. . . . . | | | 10 07 | 3 |
| Comparing the beginning at Lancaster, with the commencement observed at Kinderhook, June 16th, 1806. } . | | | 10 14 | 6 |
| Ditto the end at Lancaster with the end at Kinderhook. . . | | | 10 08 | 6 |
| By this comparison it appears that the error is in the commencement at Lancaster, and that the difference of the meridians of the two places is | | | = 10 08 | 6 |
| At Mr. Dunbar's habitation near Natchez, the conjunction } by the Commencement . . . | | | 10 15 22 | 7 |
| ——End. . . . . | | | 10 15 21 | 0 |

These results confirm the allowance of the irradiations of the semidiameters which I have adopted, it being very probable that the beginning was delayed 2″.

M. De Lalande, member of the Board of longitude, has favored me with an answer to the observations I communicated to him, it is dated Paris, 27th September, 1806, and states that he had calculated my observations at Kinderhook, and that he found

| | h | ′ | ″ |
|---|---|---|---|
| The conjunction in mean time . . . . . | 11 | 25 | 39 65 |
| In Paris by the observations of Europe. . . . . | 4 | 30 | 12 65 |
| Difference of meridians. . . . | 5 | 04 | 33 00 |

This result is the same with that established in page 273.

| | | | |
|---|---|---|---|
| By the observations of Mr. Patterson we find | | | |
| The conjunction in mean time at Philadelphia. . . . | 11 | 20 | 17 0 |
| Philadelphia west of Paris by the mean result of many observations. . | 5 | 09 | 56 5 |
| Result, conjunction in Paris mean time. . . | 4 | 30 | 13 5 |
| By the observations at Madrid and the island of Leon. | 4 | 30 | 11 6 |
| By M. Lalande. . . . . | 4 | 30 | 12 6 |
| Conjunction mean result. . . . . | 4 | 30 | 12 6 |

## *Determination of the longitude of Natchez and New-Orleans.*

| | | | |
|---|---|---|---|
| By comparison of the end observed in Kinderhook, with the end observed at Mr. Dunbar's house,—longitude west of Paris. . . . | =6 | 14 | 51 5 |
| The Fort of Natchez west. . . . . | | | 9 |
| Fort of Natchez west of Paris. . . . | 6 | 15 | 00 5 |
| New-Orleans west of Paris page 222. . = 6h 09′ 46″ | | | |
| Fort of Natchez west of New-Orleans page 159 = 5 16 | | | |
| Fort of Natchez west of Paris . . . . | 6 | 15 | 02 0 |
| Fort of Natchez west of Paris mean result. . | 6 | 15 | 01 0 |
| New-Orleans. ditto. . . . . | 6 | 09 | 45 0 |

Table of the results of geographical positions which should be substituted for those in page 273.

| | Long. W. from Paris. h ′ ″ | Latitudes. o ′ ″ |
|---|---|---|
| Bowdoin College. | 4 49 16 | 43 52 00 |
| Albany. | 5 04 25 | 42 38 38 |
| Kinderhook south landing. | 5 04 32 | 42 23 03 |
| Chancellor Levingston's place. | 5 04 58 | 42 04 39 |
| Newburg. | 5 05 21 | 41 30 20 |
| New-York. | 5 05 23 | 40 42 40 |
| Philadelphia. | 5 09 57 | 39 57 02 |
| Lancaster. | 5 14 41 | 40 02 36 |
| Williamsburg. | 5 17 04 | 37 15 50 |
| Fort at Natchez. | 6 15 01 | 31 33 48 |
| New-Orleans. | 6 09 45 | 29 57 30 |

Sum of errors of the longitudes of the moon and sun or correction to be subtracted from the new tables, supposing exact the longitude of the sun ==27″ 5
North latitude of the moon in conjunction at 4h 30′ 12″ 6=19′ 27″ 1
Correction of the Tables = + 10″ 9

## *Investigation of the semidiameters of the sun and moon.*

| | | |
|---|---|---|
| The horizontal semidiameter of the ☽ in conjunction is by the tables | | 16′ 26″ 85 |
| idem. ⊙ | | 15 46 04 |
| Difference of the horizontal semidiameter by the tables | | 40 81 |
| Supposing the correction of the tables in latitude of the moon. | =+ | 10″ 9 then |
| Difference of the horizontal semidiameters in conjunction. | | |
| For the observed duration of total obscurity at Kinderhook. | | 38 72 |
| For Albany, supposing the duration of total obscurity 4′ 41 | | 38 85 |
| For Boston, ditto ditto. 4 38 | | 39 64 |
| Mean difference of the horizontal semidiameter in conjunction. | | 39 07 |

It is to be remarked that the difference of the semidiameters, resulting from the total eclipse is that of the lowest points of the moon's surface, as, according to the statement, page 266, "4″ or 5″ before the total obscurity, the remainder of the disk "of the sun was reduced to a very short line, interrupted in "many parts."

At this time the most prominent points of the lunar disk were projected on the sun; consequently, the duration of the total obscurity, had it not been for the concavities of the limb of the moon, would have been at Kinderhook 4′ 46″ instead of 4′ 37″, as it was observed. Supposing the duration of total obscurity to have been 4′ 46″,

| | |
|---|---|
| The difference of semidiameters would be augmented. | 1″ 80 |
| Difference by the above mean | 39 07 |
| Difference of semidiameters reckoned from the most prominent points of the ☽ | 40 87 |

| | | | |
|---|---|---|---|
| By the duration between the beginning and end of the eclipse, at Kinderhook we find the sum of the horiz. semid. reduced to the time of the conjunc. | 32′ | 08″ | 39 |
| If we suppose that the true duration was greater than what was observed, by 4″, which appears very probable, we shall have. . . | 32 | 09 | 17 |
| By the observation at Natchez, supposing the beginning 4″ before it was perceived by Mr. Dunbar. . . . . | 32 | 09 | 00 |
| Sum of the horiz. semidiam. in conjunction by a mean of the observations | 32 | 09 | 08 |
| Comparing these sums and differences of semidiameters with the tables we find the correction of the semidiameter of the ☽. . | —1″ | 93 | |
| Idem. . . . . ⊙. . | —1 | 87 | |

The occultation of Spica Virginis, May 24th, 1801, was observed in all Europe, the observations most to be confided in and the most proper to determine the diameter of the moon are the following.

| | | h | ′ | ″ |
|---|---|---|---|---|
| At the National Observatory at Paris by M. Mechain. | Im. Mean time. . | 9 | 05 | 42 4 |
| | Em. . . . | 10 | 16 | 37 2 |
| Military School. . . . . | Im. Mean time. . | 9 | 05 | 28 9 |
| | Em. . . . | 10 | 16 | 24 2 |
| Royal observatory in the island of Leon. | Im. Mean time. . | 8 | 49 | 16 2 |
| | Em. . . . | 9 | 29 | 01 9 |

Making use of the elements of the new tables, I find

| | | | |
|---|---|---|---|
| Conjunction in Paris (National Observatory) mean time = | 10h | 02′ | 47″ 7 |
| Island of Leon (Royal Observatory) . | 9 | 28 | 37 0 |
| Difference of meridians. . . . | 00 | 34 | 10 7 |

| | | | |
|---|---|---|---|
| Difference of latitudes in conjunction by the observations in the island of Leon. . . . . | 51′ | 19″ | 5 |
| Correction of the semidiameters of the ☽ by the observations of M. Mechain, combined with the difference of latitudes observed in the island of Leon. . . . . = | — | 2 | 0 |
| By the observations in the Military School. . . . . — | — | 1 | 65 |
| Mean correction. — | — | 1 | 82 |

I have also calculated the annular eclipse, April 1st, 1764, by the new tables, and have deduced

Correction of the semidiameter of the ☽ = — 1″ 35
Idem. . . . . ⊙ — 2 15

## *Recapitulation of the different results.*

| | Correction of the diameters. ⊙. | ☽. |
|---|---|---|
| By total eclipse 1806. . . . . | 1″ 87 | 1″ 93 |
| Annular eclipse 1764. . . . . | 2 15 | 1 35 |
| Occultation of Spica Virginis above. . . . . | | 1 82 |
| Passage of Mercury page 232. . . | 1 50 | |
| Mean correction. . . . . | 1 84 | 1 70 |
| Semidiameter of the ⊙ in apogee by the tables. . . . | | 15′ 45″ 50 |
| Correction by the above observations. . . . | | 1 84 |
| Semidiameter of the ⊙ in apogee. . . . . | | 15 43 66 |
| Therefore diameter of the ⊙ in apogee. . . . | | 31 27 32 |

| | | | |
|---|---|---|---|
| Semidiameter corresponding to the constant lunar parallax of the tables. | 15′ | 33″ | 69 |
| Correction. . . | | 1 | 70 |
| Constant semidiameter of the ☽ . . . . . | 15 | 31 | 99 |
| Therefore constant diameter of the ☽ . . . . . | 31 | 03 | 98 |

From this statement, it will appear, that the semidiameter of the moon, ascertained in the occultations, may vary 2″ on account of the irregularities of the disk of the moon; it may be further remarked, that the periodical variations of the parallax of the moon, by the new tables, are those which Mayer found by his theory, and which differ from the coefficients determined by Laplace. According to the calculations of Mr. Burckhardt, the sum of the periodical differences of the two authors above mentioned, may, under very extraordinary circumstances, amount to 7″.—In this case the uncertainty of the semidiameter of the moon would be 1″ 9.

In the explanation of these tables, it is maintained that M. Burg has diminished the diameter of the moon by 2″, but it is easy to see that the diameter of the moon by these tables, is the same as has been determined by M. De Lalande. For the proportion of the horizontal equatorial parallax of the moon, and the horizontal diameter of the moon according to Burg, is 60 : 32′ 45″ 1.

According to De Lalande, the proportion between the horizontal parallax at Paris and the horizontal diameter of the moon, 60 : 32′ 46″ 6, vide the tables of the third edition of his astronomy, printed in 1797, page 77.

| | |
|---|---|
| According to Burg, the constant equatorial parallax. . . | =57′ 01″ 0 |
| De Lalande, for Paris. . . . . | =56 58 3 |

And although the constant parallax of De Lalande referred to the equator differs nearly 4″, nevertheless, the constant semidiameters are the same.

From the above data, the horizontal diameter of the moon corresponding to the constant parallax for Paris, will be,

$$\text{according to De Lalande} = \frac{32' 46'' 6 \times 56' 58'' 3}{60} = 31' 07'' 35$$

$$\text{Burg. .} = \frac{32' 41'' 1 \times 57' 01'' 0}{60} = 31' 07'' 39$$

which proves that the results are sensibly the same.